

X-616-68-372

NASA TM X-63370

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GPO PRICE \$ _____

CFSTI PRICE(S) \$ _____

Hard copy (HC) 3.00

Microfiche (MF) 1.65

ff 653 July 65

SEPTEMBER 1968



GODDARD SPACE FLIGHT CENTER

GREENBELT, MARYLAND

N 68-37820

FACILITY FORM 502

(ACCESSION NUMBER)

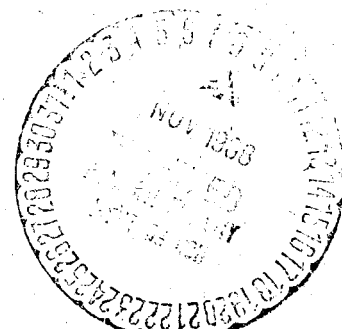
29
(PAGES)

TMX 63370
(NASA CR OR TMX OR AD NUMBER)

(THRU)

1
(CODE)

30
(CATEGORY)



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September 1967

Increased use of data from several satellites for correlative studies of the outer magnetosphere, magnetosheath, bow shock and interplanetary shocks, discontinuities and general properties has made it highly desirable to have plots available of the relative locations of the satellites potentially of interest. Beginning in July 1966, three IMP class satellites have been launched which are well suited for such correlative studies in or near cislunar space. They are:

- (1) Explorer 33, launched into a high apogee-perigee orbit on July 1, 1966;
- (2) Explorer 34, placed in a high inclination orbit on May 24, 1967;
- (3) Explorer 35, launched on July 19, 1967 and injected into lunar orbit on July 22.

This document consists of solar ecliptic plane projections of the orbits of these three satellites. The orbits of Explorer 33 from launch through June 1967 are summarized in Figures 1 and 2. Day numbers used on those figures are decimal day of the year, where January 1 is day 0 and July 1 is day 181 (or 182 in the case of leap year). Figure 3 shows segments of Explorer 33 orbits of interest for near earth studies in the night side magnetosphere. They correspond to passes during December 1966 to February 1967. The begin and end points of each segment are identified by decimal day and Universal Time. In addition, the distance from the ecliptic plane of the midnight meridian plane crossing point is given in earth radii for each pass.

The approximate positions and orientations of Explorer 34 orbits 1-50 (May 24 to December 26, 1967) are summarized in Figure 4. The period of the Explorer 34 orbit is $4\frac{1}{3}$ days. Table 1 lists apogee and perigee times for orbits 1-13 for use in correlating the Explorer 34 position with that of Explorer 33 during May to July 1967.

With the launch of Explorer 35 the three satellites were in orbit simultaneously, and each of the remaining figures (5-15) shows the projections of the orbits of all three spacecraft for successive periods of one month. These figures collectively cover the period from July 1967 to June 1968. The plots of Explorer 34 orbits 61-88 are predicted trajectories. Orbit numbers are the circled numbers.

Experimental data from Explorers 33 and 35 are processed on a weekly basis while Explorer 34 data are processed by orbit. To assist in the use of data from these spacecraft, Tables 2-4 give the begin date for each week of 33 and 35 data through June 1968 and for each of orbits 1-6 of 34, respectively. In addition to month and day of month, the corresponding decimal day of the year is also given for each date.

It is anticipated that this document will serve as an initial attempt to stimulate collaboration not only between experimenters on these satellites but also with those on the Vela and OGO spacecraft as well as on other Explorers. Also we believe that this document will serve as a useful reference for investigators using ground based observations of geophysical and solar phenomena and thereby provide

an encouragement to their direct solicitation of explicit spacecraft data for similar correlative studies. Several publications by the GSFC group conducting magnetic field experiments on these satellites have already appeared which include some of these data. These are included in the bibliography.

It may be of interest to users of this document that IMP 3 was also operating during 1965-1967. IMP-3 was on Orbit 69 when Explorer 33 was launched. Apogee of IMP-3 was near the dusk meridian at a distance of $37 R_E$ in July 1966. Apogee was located near the noon meridian in early October 1966 and near the dawn meridian in early January 1967. This spacecraft continued to provide experimental data through orbit 117, up to mid-April 1967, when apogee was in the geomagnetic tail near the midnight meridian.

BIBLIOGRAPHY

- Behannon, Kenneth W., Mapping of the Earth's Bow Shock and Magnetic Tail by Explorer 33, J. Geophys. Res., 73, 907-930, 1968.
- Behannon, Kenneth W., Intrinsic Magnetic Properties of the Lunar Body, NASA-GSFC preprint X-616-68-171, May 1968.
- Behannon, K. W. and D. H. Fairfield, Spatial Variations of the Magnetosheath Magnetic Field, Presented at the International Symposium on the Physics of the Magnetosphere, Washington, D.C. September 3-13, 1968.
- Fairfield, D. H., Simultaneous Measurements on Three Satellites and the Observation of the Geomagnetic Tail at 1000 R_E , J. Geophys. Res., 73, October 1, 1968.
- Fairfield, D. H., The Average Magnetic Field Configuration of the Outer Magnetosphere, NASA-GSFC Preprint X-616-68-197, June 1968; Presented at the International Symposium on the Physics of the Magnetosphere, Washington, D.C., September 3-13, 1968.
- Ness, N. F., Lunar Explorer 35, NASA-GSFC preprint X-616-68-166 May 1968; Presented at XIth COSPAR, Tokyo, Japan, May 16, 1968.
- Ness, N. F., The Geomagnetic Tail, NASA-GSFC Preprint X-616-68-345, September 1968; Presented at the International Symposium on the Physics of the Magnetosphere, Washington, D.C, September 3-13, 1968.
- Ness, N. F., K. W. Behannon, S. C. Cantarano and C. S. Scearce, Observations of the Earth's Magnetic Tail and Neutral Sheet at 510,000 Kilometers by Explorer 33, J. Geophys. Res., 72, 927-933, 1967.
- Ness, N. F., K. W. Behannon, C. S. Scearce and S. C. Cantarano, Early Results from the Magnetic Field Experiment on Lunar Explorer 35, J. Geophys. Res., 72, 5769-5778, 1967.
- Ness, N. F., K. W. Behannon, H. E. Taylor and Y. C. Whang, Perturbations of the Interplanetary Magnetic Field by the Lunar Wake, J. Geophys. Res., 73, June 1, 1968.
- Ness, N. F., Y. C. Whang, H. E. Taylor and K. W. Behannon, Solar Plasma Flow Past the Moon, NASA-GSFC preprint X-616-68-277, July 1968; to be published in Proceedings of the Sixth International Symposium on Rarefied Gas Dynamics.

Taylor, H. E., K. W. Behannon and N. F. Ness, Measurements of the Perturbed Interplanetary Magnetic Field in the Lunar Wake, J. Geophys. Res., 73, November 1, 1968.

Taylor, H. E. and N. F. Ness, Observations of the Interplanetary Magnetic Field July 4-12, 1966, NASA-GSFC preprint X-612-67-345, July 1967; Presented at London COSPAR Proton Flare Project, July 27-28, 1967.

Van Allen, J. A. and N. F. Ness, Observed Particle Effects of an Interplanetary Shock Wave on July 8, 1966, J. Geophys. Res., 72, 935-942, 1967.

TABLE 1

EXPLORER 34 PERIGEE AND APOGEE TIMES AND DISTANCES

ORBIT	PERIGEE			APOGEE		
	TIME	DISTANCE(KM)		TIME	DISTANCE(KM)	
1	5/24/67	1406	LAUNCH	5/26/67	1801-1813	211024
2	5/28/67	2157	278	5/31/67	0143-0154	211077
3	6/2/67	0542	310	6/4/67	0925-0939	210992
4	6/6/67	1322	328	6/8/67	1659-1714	210849
5	6/10/67	2050	330	6/13/67	0032-0048	210979
6	6/15/67	0439	458	6/17/67	0822-0837	210657
7	6/19/67	1218	628	6/21/67	1554-1609	210540
8	6/23/67	1947	636	6/25/67	2332-2344	210682
9	6/28/67	0330	669	6/30/67	0717-0726	210642
10	7/2/67	1113	698	7/4/67	1453-1508	210518
11	7/6/67	1846	704	7/8/67	2226-2235	210475
12	7/11/67	0219	756	7/13/67	0626-0638	210954
13	7/15/67	1046	1078	7/17/67	1436-1437	210384

TABLE 2

EXPLORER 33 CALENDAR

Week	Begin Date	Decimal Day	Week	Begin Date	Decimal Day
1	1966 July 1	181	23	1966 Dec. 3	336
2	9	189	24	10	343
3	16	196	25	17	350
4	23	203	26	24	357
5	30	210	27	31	364
6	Aug. 6	217	28	1967 Jan. 7	6
7	13	224	29	14	13
8	20	231	30	21	20
9	27	238	31	28	27
10	Sept. 3	245	32	Feb. 4	34
11	10	252	33	11	41
12	17	259	34	18	48
13	24	266	35	25	55
14	Oct. 1	273	36	Mar. 4	62
15	8	280	37	11	69
16	15	287	38	18	76
17	22	294	39	25	83
18	29	301	40	Apr. 1	90
19	Nov. 5	308	41	8	97
20	12	315	42	15	104
21	19	322	43	22	111
22	26	329	44	29	118

Week	Begin Date	Decimal Day	Week	Begin Date	Decimal Day
45	1967 May 6	125	68	1967 Oct. 14	286
46	13	132	69	21	293
47	20	139	70	28	300
48	27	146	71	Nov. 4	307
49	June 3	153	72	11	314
50	10	160	73	18	321
51	17	167	74	25	328
52	24	174	75	Dec. 2	335
53	July 1	181	76	9	342
54	8	188	77	16	349
55	15	195	78	23	356
56	22	202	79	30	363
57	29	209	80	1968 Jan. 6	5
58	Aug. 5	216	81	13	12
59	12	223	82	20	19
60	19	230	83	27	26
61	26	237	84	Feb. 3	33
62	Sept. 2	244	85	10	40
63	9	251	86	17	47
64	16	258	87	24	54
65	23	265	88	Mar. 2	61
66	30	272	89	9	68
67	Oct. 7	279	90	16	75

<u>Week</u>	<u>Begin Day</u>	<u>Decimal Day</u>
91	1968 Mar. 23	82
92	30	89
93	Apr. 6	96
94	13	103
95	20	110
96	27	117
97	May 4	124
98	11	131
99	18	138
100	25	145
101	June 1	152
102	8	169

TABLE 3

EXPLORER 35 CALENDAR

Week	Begin Date	Decimal Day	Week	Begin Date	Decimal Day
1	1967 July 19	199	25	1968 Jan. 4	3
2	27	207	26	11	10
3	Aug. 3	214	27	18	17
4	10	221	28	25	24
5	17	228	29	Feb. 1	31
6	24	235	30	8	38
7	31	242	31	15	45
8	Sept. 7	249	32	22	52
9	14	256	33	29	59
10	21	263	34	Mar. 7	66
11	28	270	35	14	73
12	Oct. 5	277	36	21	80
13	12	284	37	28	87
14	19	291	38	Apr. 4	94
15	26	298	39	11	101
16	Nov. 2	305	40	18	108
17	9	312	41	25	115
18	16	319	42	May 2	122
19	23	326	43	9	129
20	30	333	44	16	136
21	Dec. 7	340	45	23	143
22	14	347	46	30	150
23	21	354	47	June 6	157
24	28	361			

TABLE 4
EXPLORER 34 CALENDAR

Orbit	Begin Date	Decimal Day	Orbit	Begin Date	Decimal Day
1	1967 May 24	143	24	1967 Sept. 1	243
2	28	147	25	5	247
3	June 2	152	26	9	251
4	6	156	27	14	256
5	10	160	28	18	260
6	15	165	29	22	264
7	19	169	30	26	268
8	23	173	31	Oct. 1	273
9	28	178	32	5	277
10	July 2	182	33	10	282
11	6	186	34	14	286
12	11	191	35	18	290
13	15	195	36	23	295
14	19	199	37	27	299
15	24	204	38	31	303
16	28	208	39	Nov. 5	308
17	Aug. 1	212	40	9	312
18	6	217	41	13	316
19	10	221	42	18	321
20	14	225	43	22	325
21	19	230	44	26	329
22	23	234	45	Dec. 1	334
23	27	238	46	5	338

<u>Orbit</u>	<u>Begin Date</u>	<u>Decimal Day</u>
47	1967 Dec. 9	342
48	13	346
49	18	351
50	22	355
51	26	359
52	31	364
53	1968 Jan. 4	3
54	8	7
55	13	12
56	17	16
57	21	20
58	26	25
59	30	29
60	Feb. 3	33

EXPLORER 33 TRAJECTORY SOLAR ECLIPTIC PLANE PROJECTION

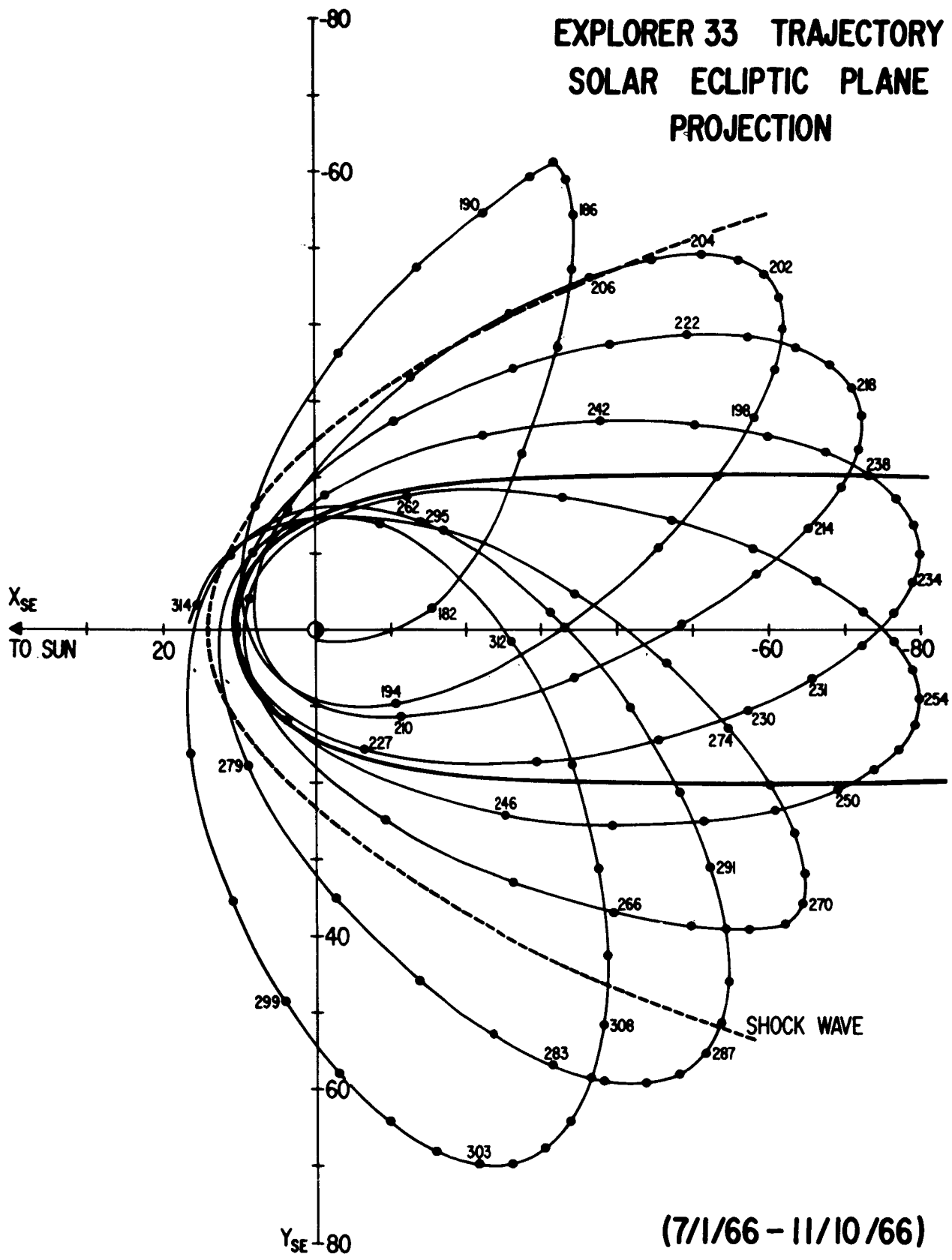


FIGURE 1

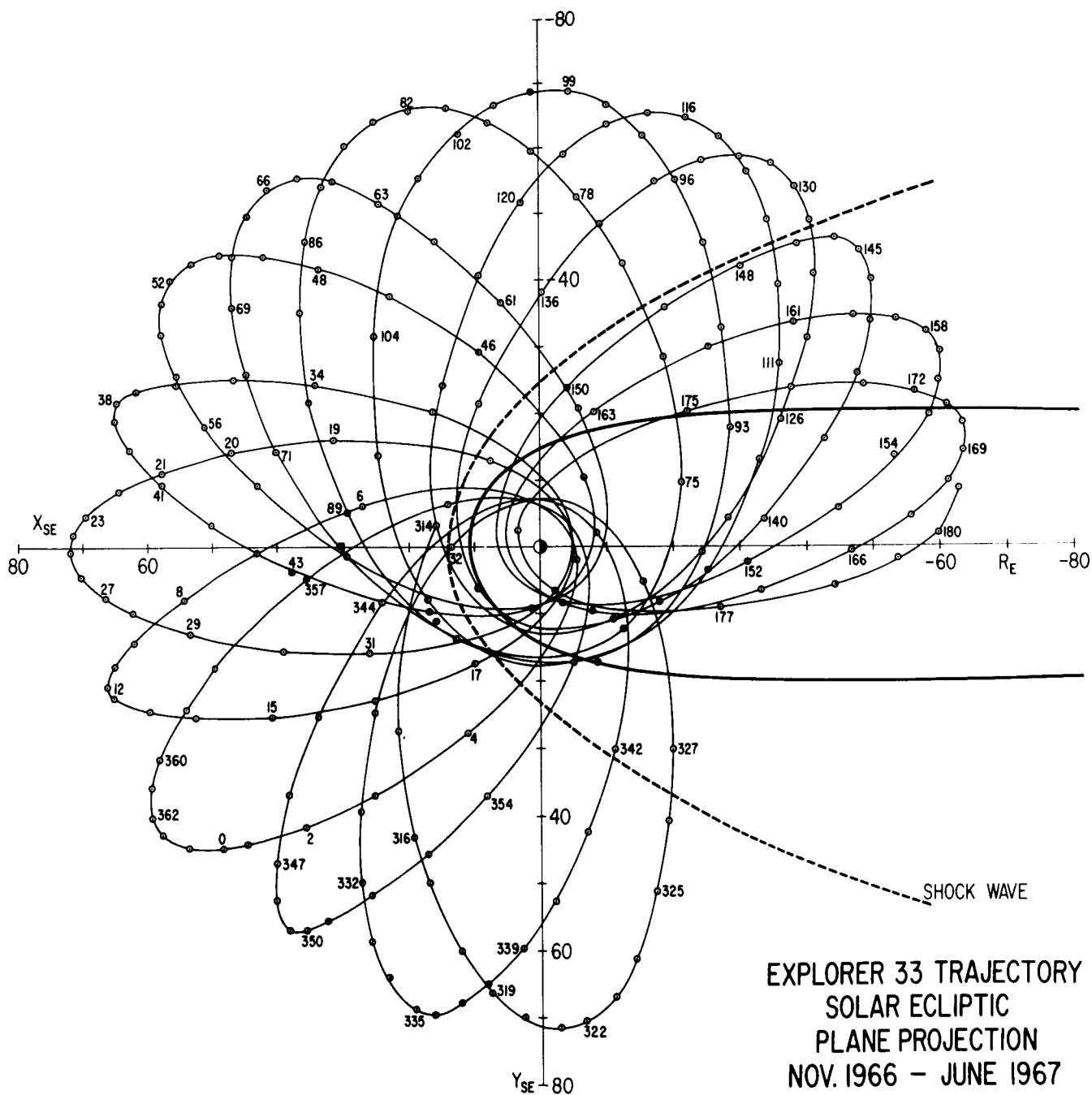
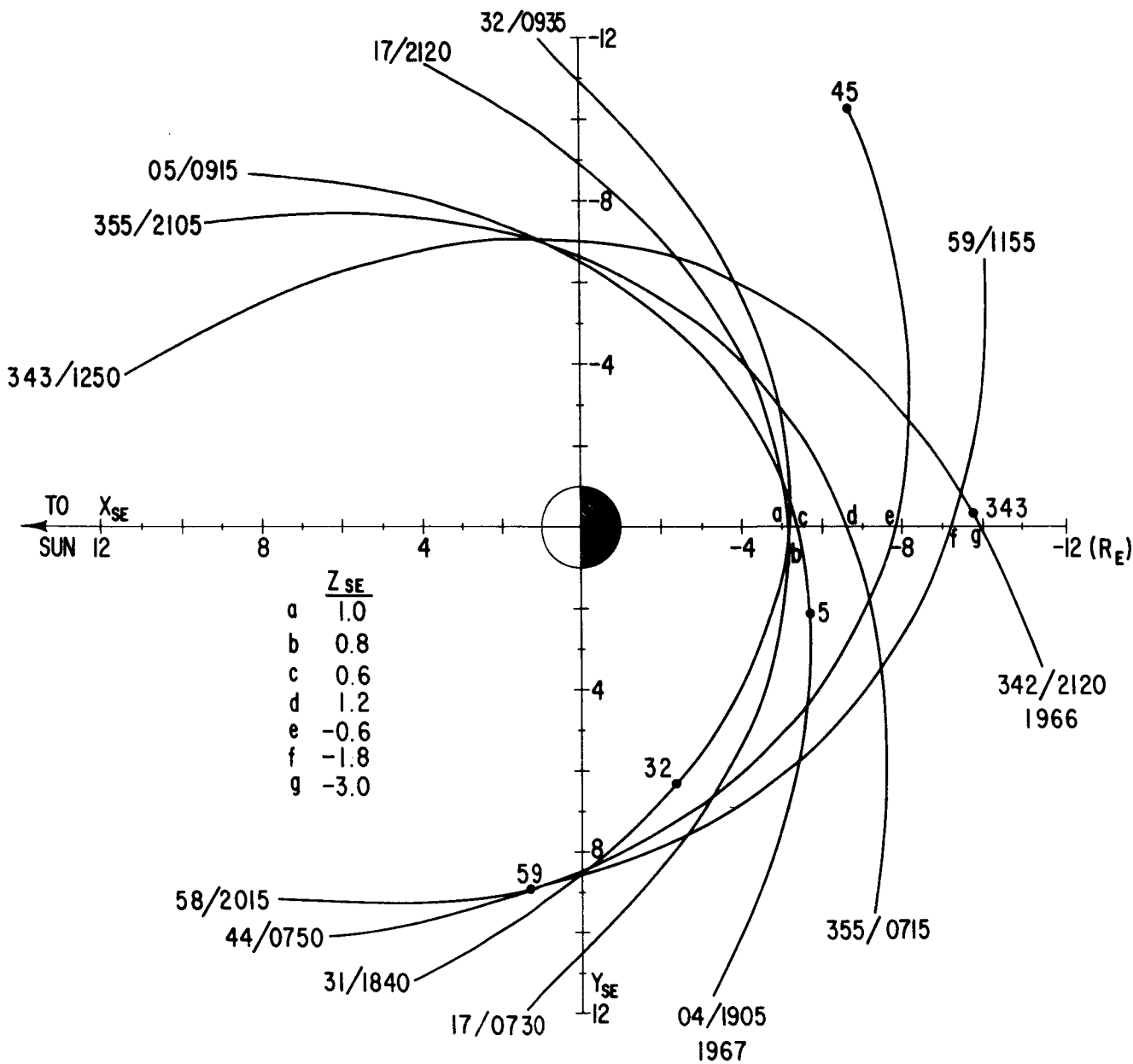


FIGURE 2



EXPLORER 33 DEC 1966 -FEB 1967

FIGURE 3

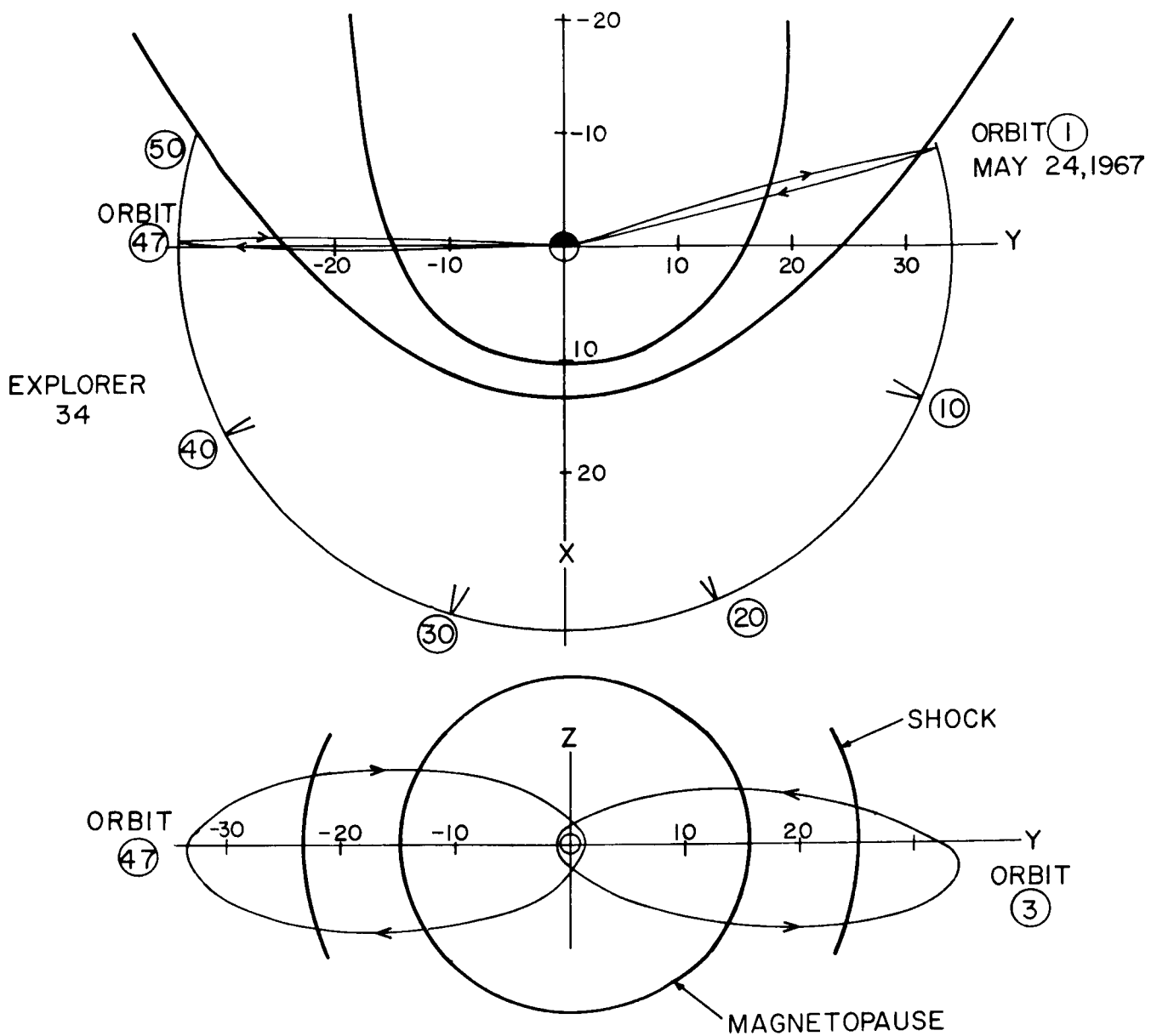
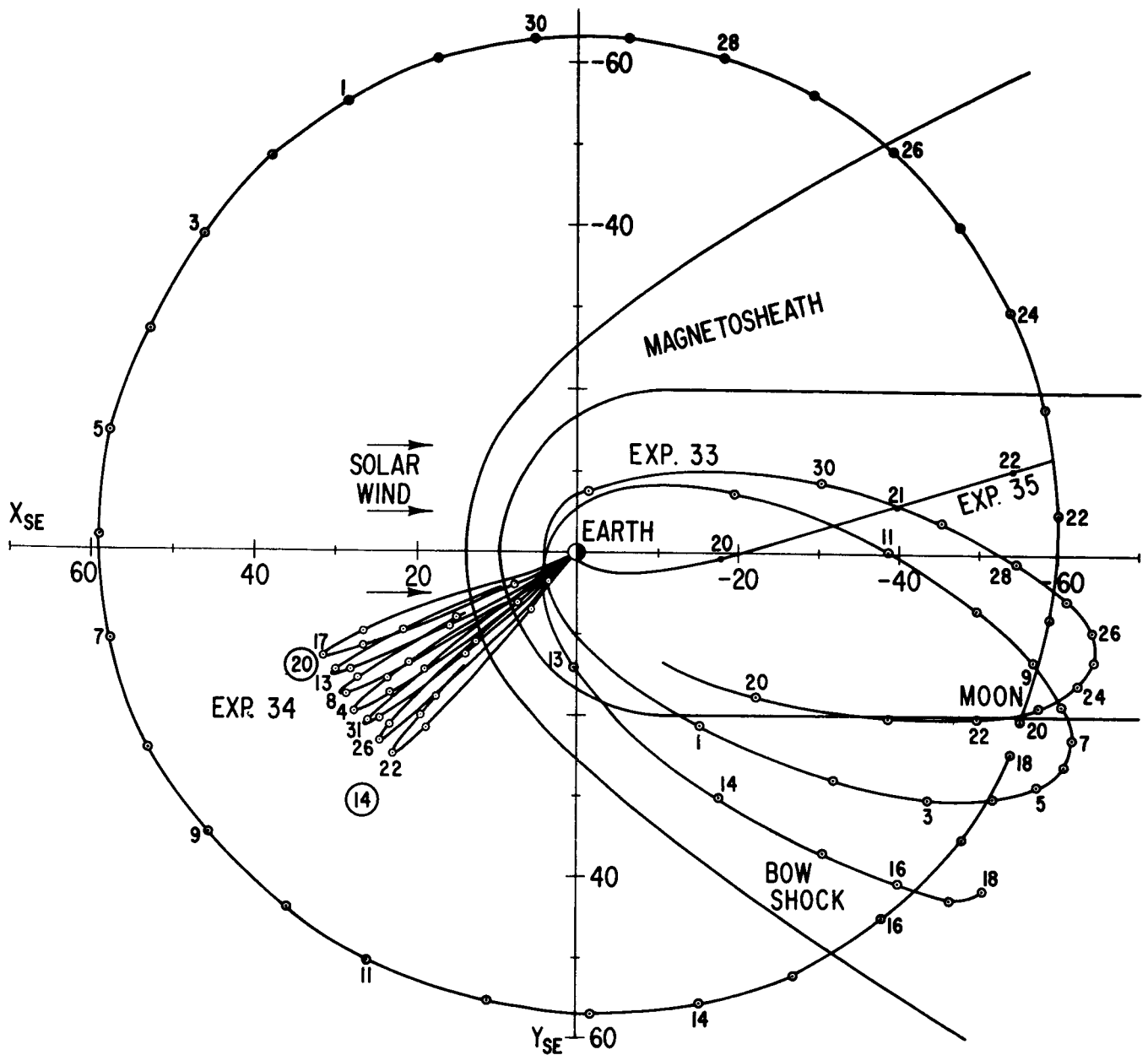
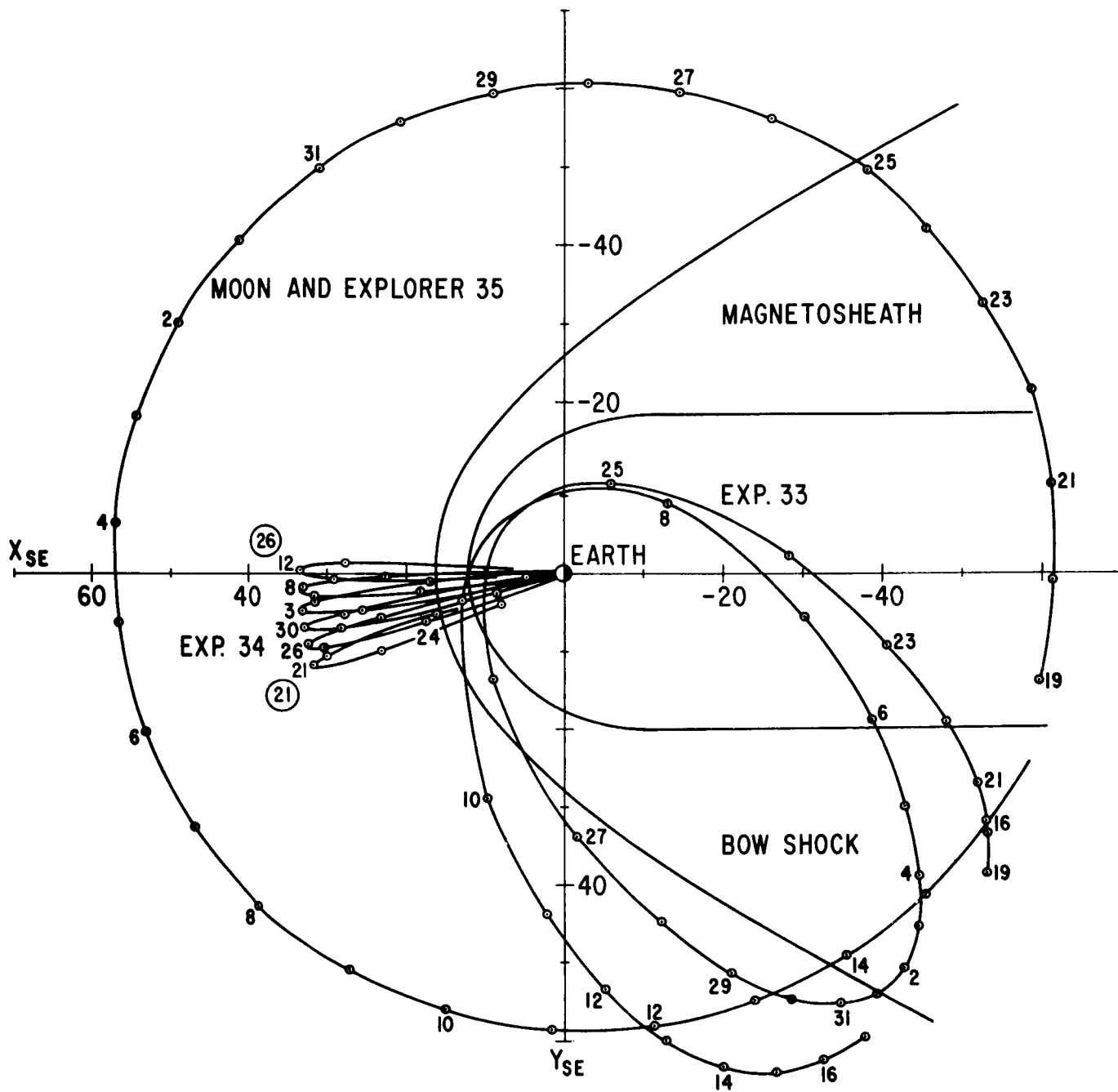


FIGURE 4



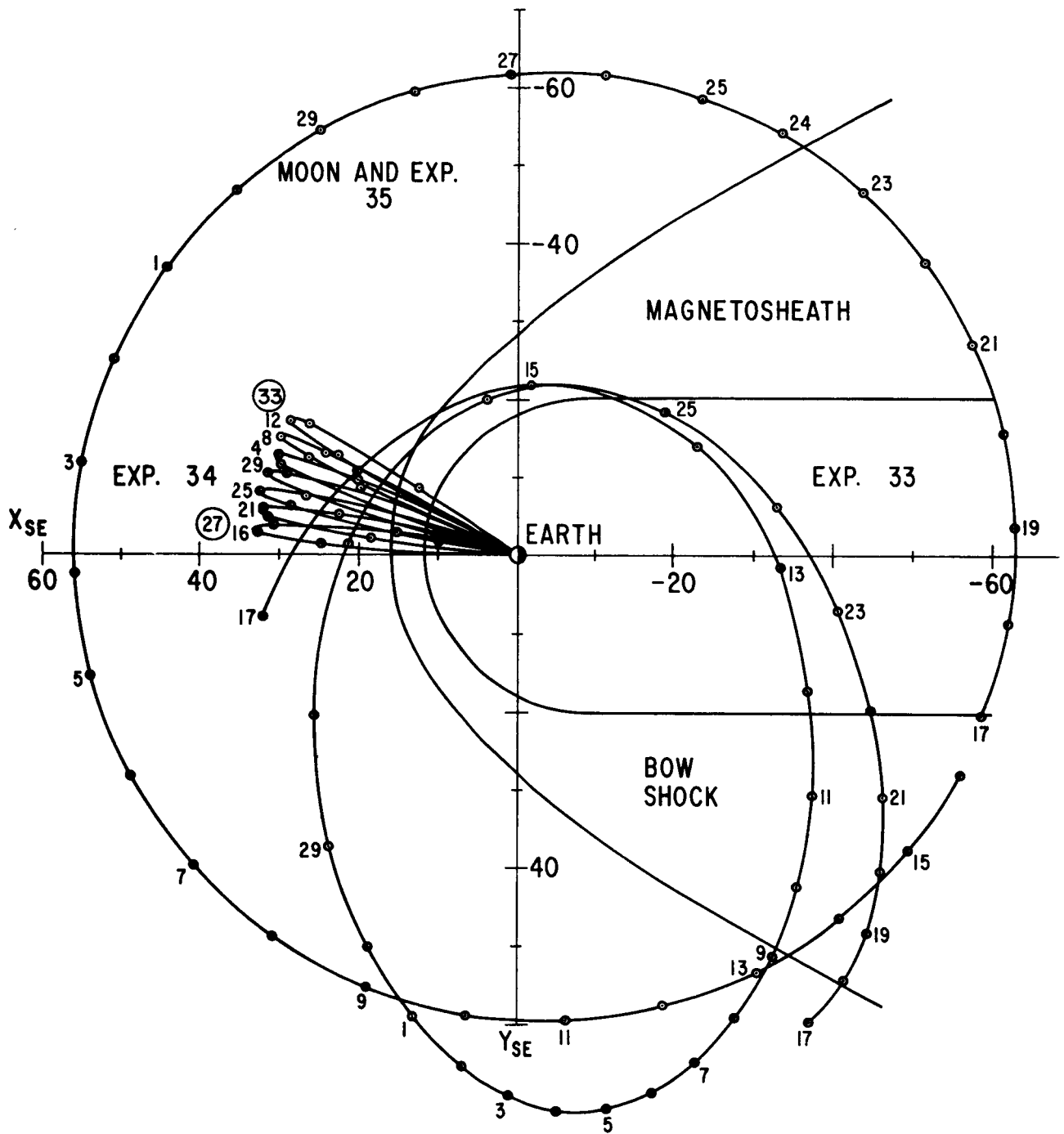
MOON AND EXPLORERS 33, 34, 35 - JULY - AUGUST 1967

FIGURE 5



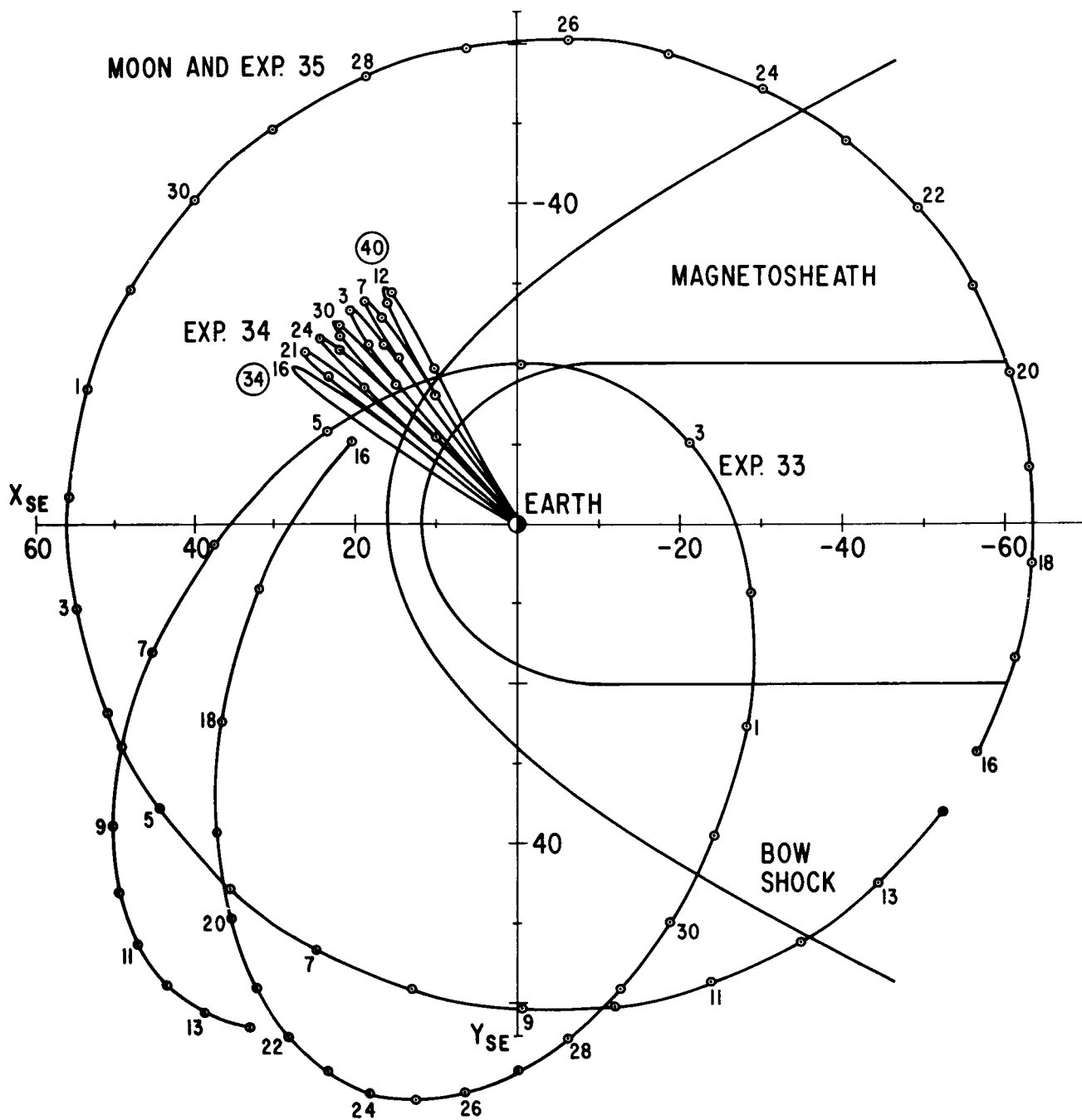
AUGUST-SEPTEMBER 1967

FIGURE 6



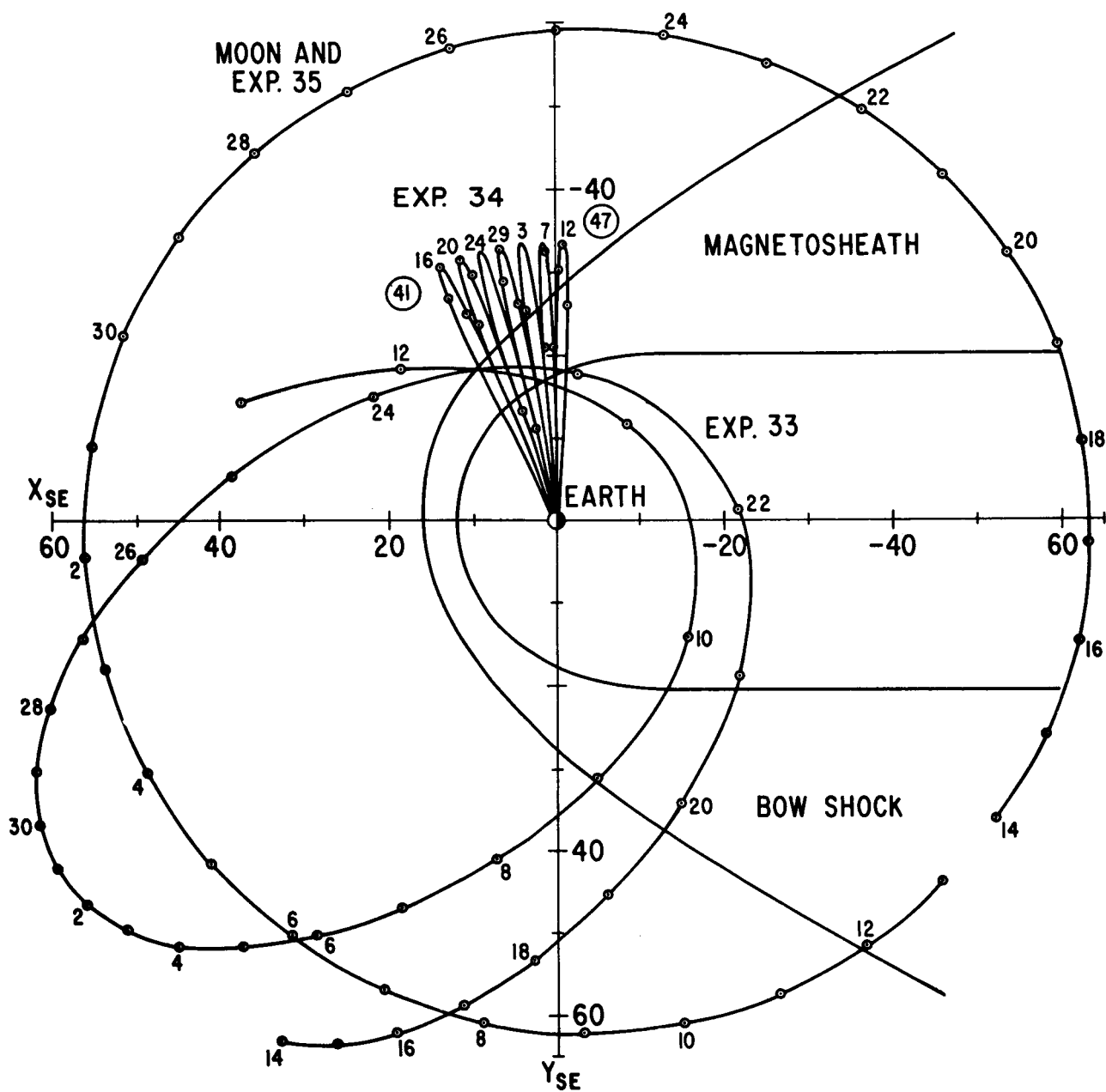
SEPTEMBER-OCTOBER 1967

FIGURE 7



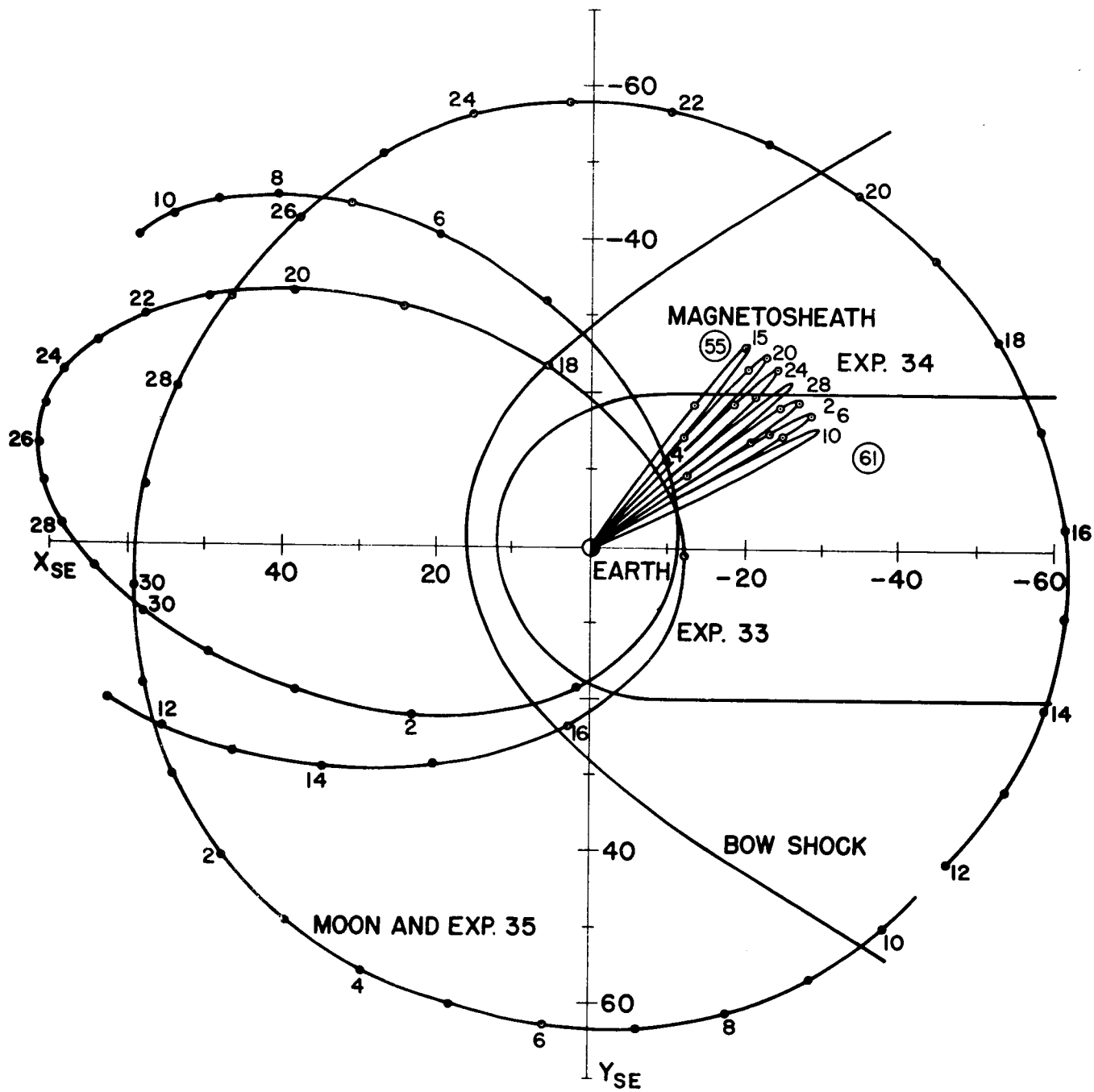
OCTOBER–NOVEMBER 1967

FIGURE 8



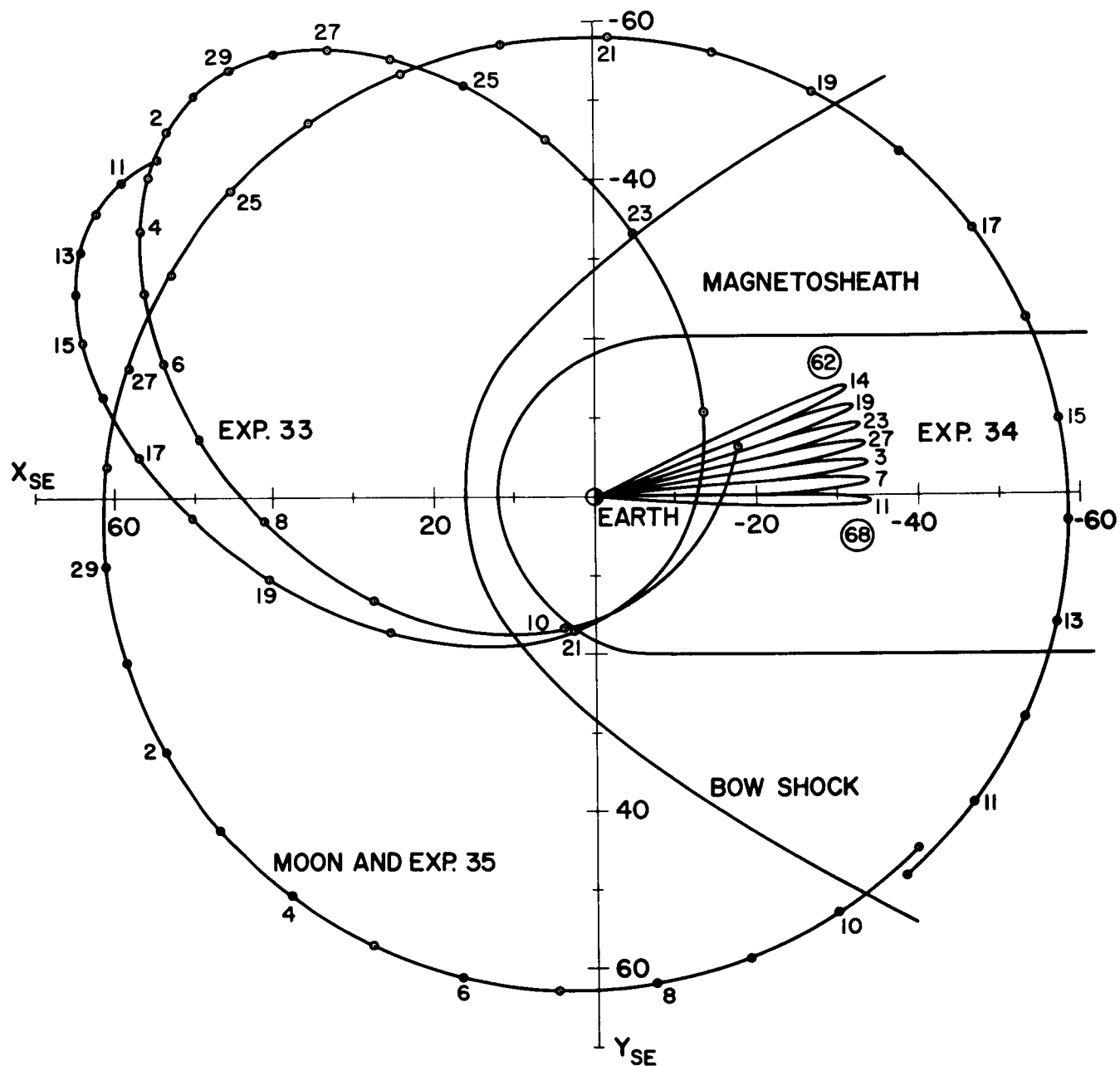
NOVEMBER-DECEMBER 1967

FIGURE 9



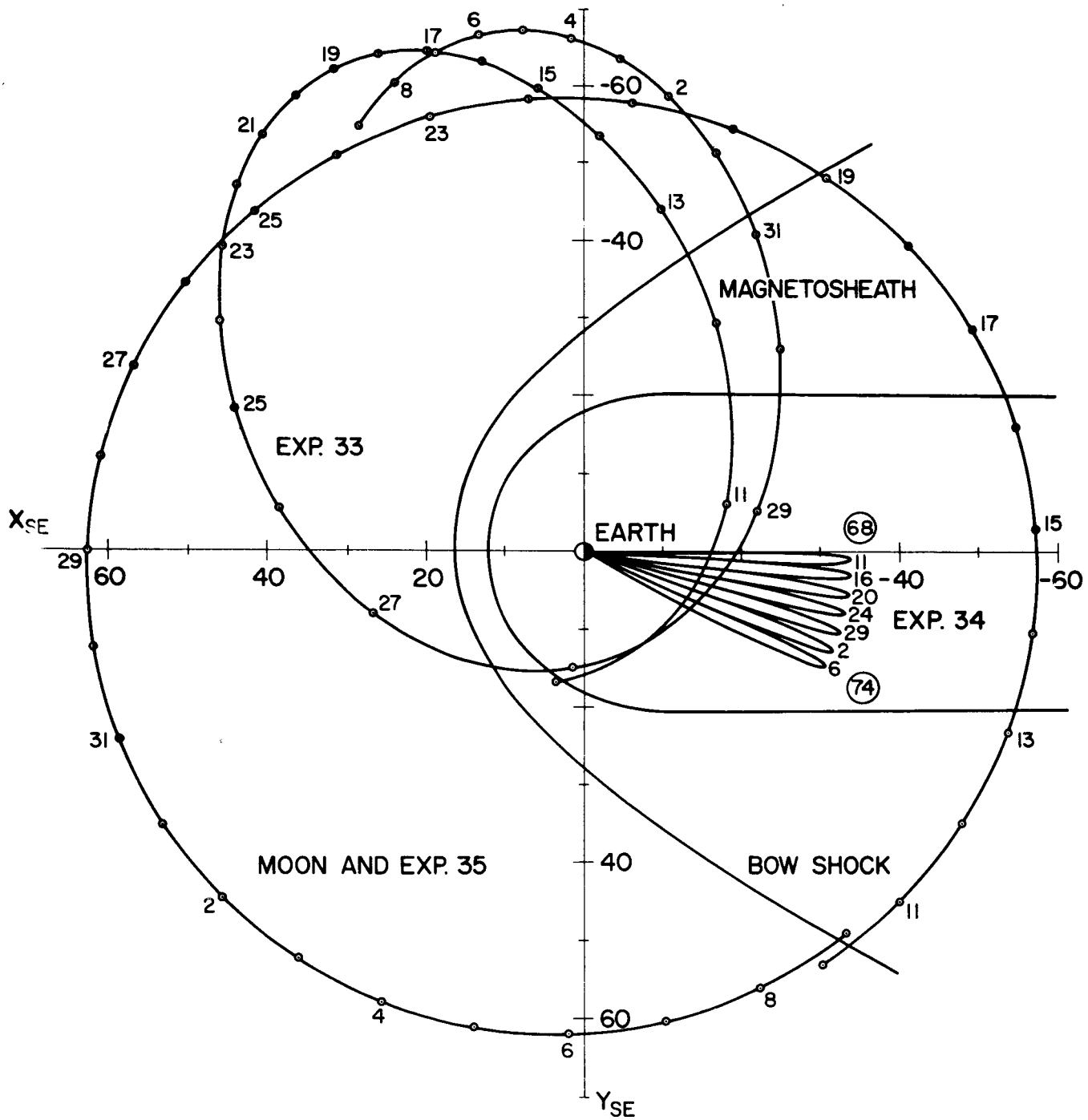
JANUARY-FEBRUARY 1968

FIGURE 11



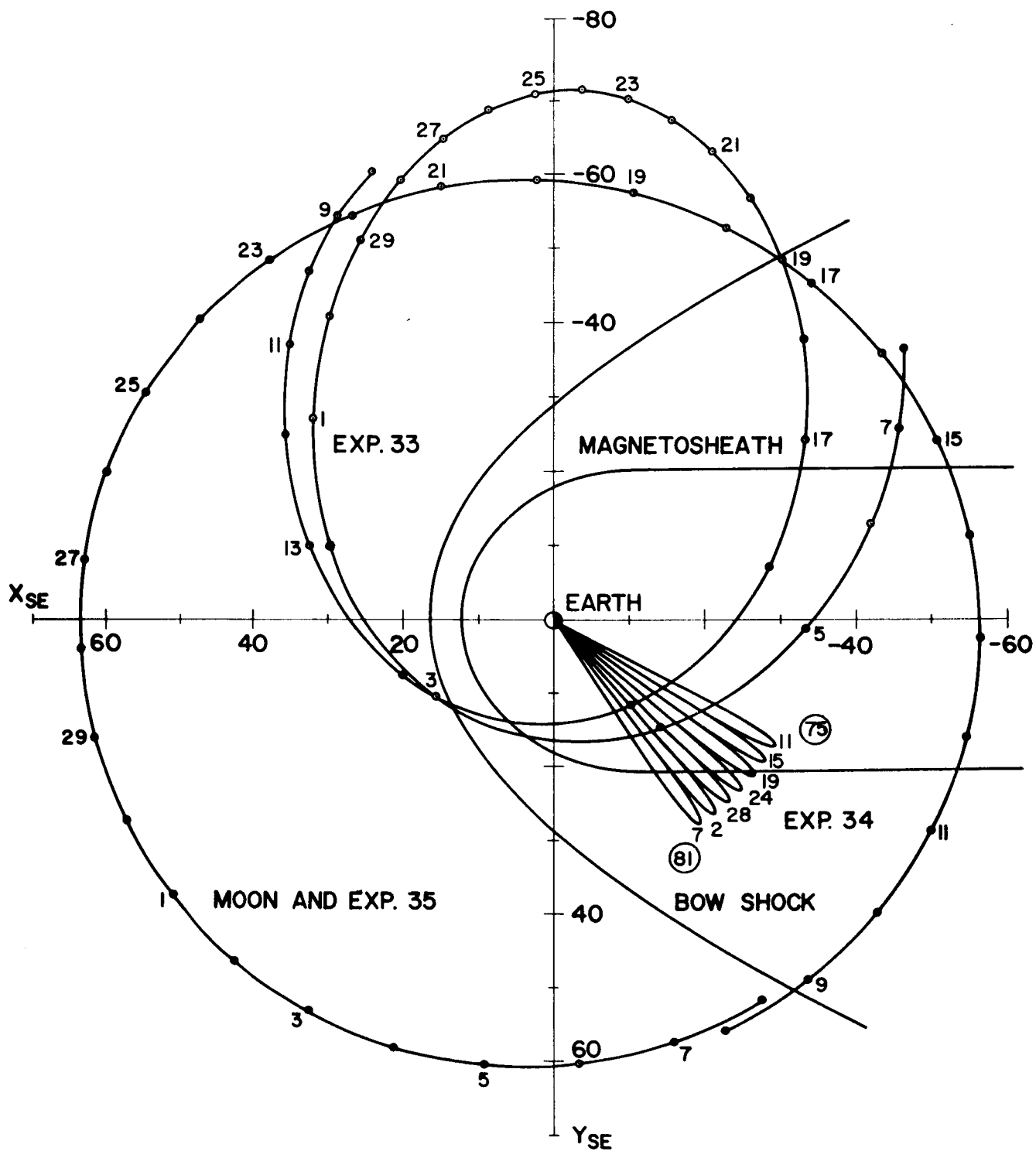
FEBRUARY-MARCH 1968

FIGURE 12



MARCH - APRIL 1968

FIGURE 13



APRIL-MAY 1968

FIGURE 14

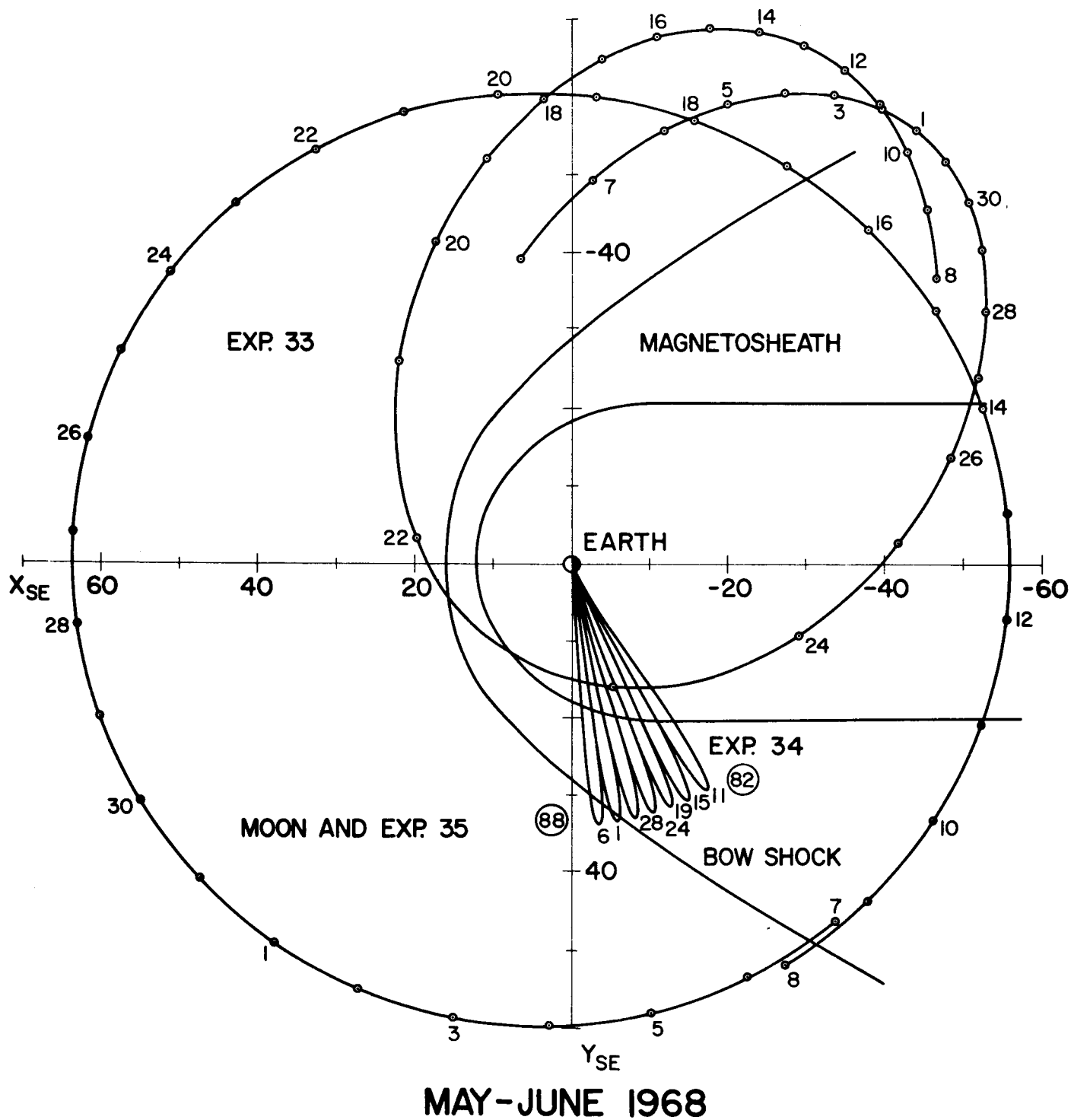


FIGURE 15